

## **Topographic databases on the border states.**

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### **Abstract**

Work on the harmonization and interoperability of databases have started in the last century, and gained real momentum in Europe with the work on the INSPIRE Directive and its implementation into the legal system obligatory in each countries of the European Union. Previously issues related to harmonization and interoperability was concerned, only in a limited range, on spatial databases within countries. The exchange of data between different systems within one country still makes a lot of problems. Much more complicated issue is the exchange of data between countries and their integration using different methods and different levels of integration.

The cooperation of Polish and German geodetic and cartographic services is based on the agreements on *Cooperation and enabling mutual access to geodetic, cartographic and photogrammetric data and geographic databases* signed in 2008 and 2009 by the Surveyor General of Poland with the three neighboring german lands: Saxony, Brandenburg and Mecklenburg and Vorpommern. One of the results of signed agreements are work on a coherent model of topographic objects database in the border area, using topographic objects collected in the databases: BDOT10k in Poland and ATKIS in Germany. Works rely on performed the expertises in the field of harmonization of topographic objects database in the border area.

Each country describing country's space by spatial database models with an accuracy of maps in the scale of 1:10 000, refers to their traditions and experiences on topographic cartography. The method of describing a similar area on the border of the state usually takes differing models of spatial data. The same objects in neighboring countries can be classified in different categories of objects with different attributes and different ways named and defined.

Fundamental premise to undertake the work on harmonization, interoperability and integration of topographic databases on the polish – german border is the fact that at least in some parts the bases are similar. This means that the types and methods of description of the classified objects in the bases have common parts. The basis of the analyzes were data models defined in the relevant technical standards for individual databases, materials and data from

ATKIS and BDOT10k. The basis of the analyzes were the data models defined in the relevant technical standards for each database, materials and data from ATKIS and BDOT10k.

Objects from ATKI and BDOT10k databases were divided into two main groups:

- Objects that appear in one database,
- Objects that appear in both databases.

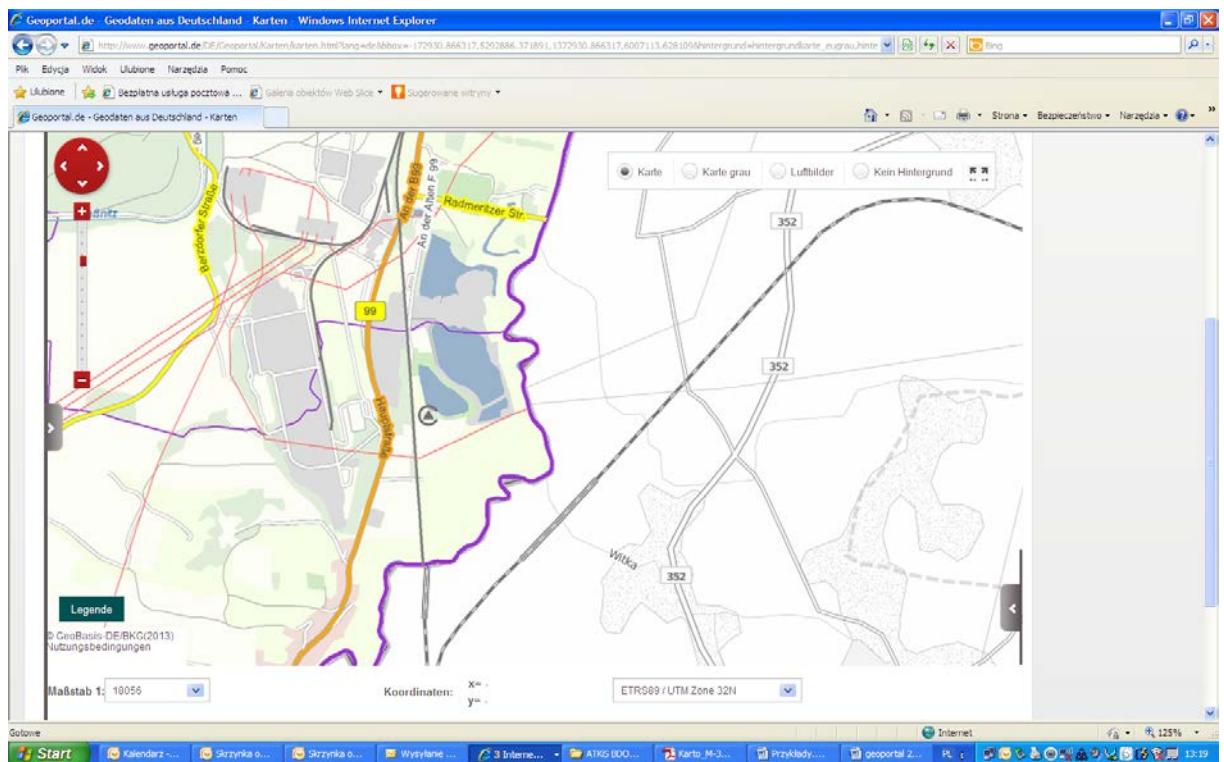
Objects from the second group (which are the subject of a possible integration) is significantly more than in the second group.

The issue of harmonize the topographic databases on the border states is an essential issue for the implementation of particle production at different scales of topographic maps in countries, as well as for the construction of domain-specific geoinformation systems, proper spatial planning and development of border regions.

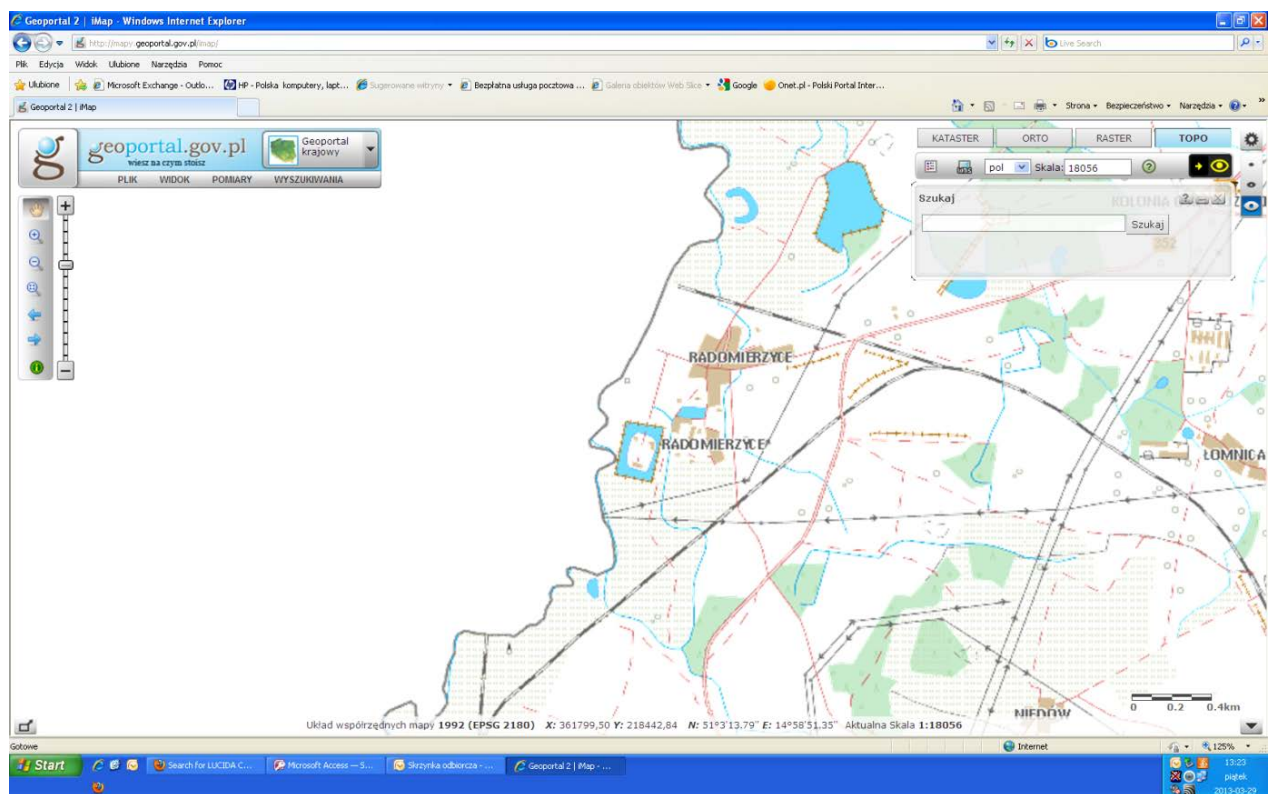
## **1. Admission**

The implementation of the INSPIRE Directive in the European Union caused issues related to the interoperability of spatial information at European level. Previously, interoperability issues, mainly related to spatial data created using a variety of systems within individual countries. However, more complicated issue is the exchange of data between different European countries and their integration especially between neighboring countries. Less of a problem in this case is the variety of systems, but much more important is the way of describing the same space. This is reflected by the existence of classes and objects characterized, named and defined in different ways. At the same time those objects relate to the same real world objects. The essence is to enable the sharing and connecting of data, especially such an exchange and integration, which in the most possible way will be automatic.

## The diversity in spatial data on the Polish and German border



[www.geoportal.de](http://www.geoportal.de)



[www.geoportal.gov.pl](http://www.geoportal.gov.pl)

## **2. Agreements on cooperation and enabling materials and databases**

The cooperation of Polish and German geodetic and cartographic services is based on the three agreements on *cooperation and enabling mutual access to geodetic, cartographic and photogrammetric data and geographic databases* signed by the Surveyor General of Poland with the three neighboring German lands:.

These agreements, are contained with:

- President of the Office of Geodetic Measurements and Geoinformation Brandenburg in November 2008;
- Director of the National Office for Internal Administration for Mecklenburg Vorpommern in March 2009;
- President of the Office of General Office of Geoinformation and Measurements Saxony in March 2009.

In the case of topographic objects database and topographic maps, sharing concerns on border areas at the waist about 25 km from the border on both sides of the border with the full complement of maps emblem of the scale. Providing the access to the materials is intended to develop the official topographic maps and prepare of geodetic and cartographic data for local and national spatial data infrastructures in each country. These agreements were concluded for a period of 5 years and shall be extended to the next calendar year, unless one of the parties to the agreement occurs with the wishes of end of cooperation. As the result of the agreements were three meetings of representatives of surveying and mapping services of Polish and German states in Dresden in July 2009, in Warsaw in 2011 and Wroclaw in 2012. During these meetings were discussed the progress of work on a coherent model of topographic objects database in the border area using topographic objects collected in the databases: BDOT10k in Poland and ATKIS in Germany. Works consisted on the work performed by experts in the field of harmonization of topographic objects database on the example of border area between the Polish Republic and the Federal Republic of Germany.

## **3. The concept of databases topographic features harmonization on the Polish – German boundaries.**

The basis of the concept was comparative analysis of the information content of the systems ATKIS and BDOT10k TBD (the latest version of Polish technical standard for conducting topographic database objects). First of all, we need to assumed that the description of the

space in this two systems, are similar at least in some parts. It means that the types and description of the specific objects, classified in the mentioned systems will have common parts. The basis of the analysis were the materials and data provided by the polish-german agreement.

In both systems all objects in both systems were classified into two groups:

1. First objects that are only found in one system, eg: class AX\_Hafenbecken (docks) located only in ATKIS or "drainage ditch" occurs only in the TBD (Expert, 2009).
2. Second objects that are present in both systems. Objects belonging to the first group is much less than those that assigned into the second group. For obvious reasons, the second group was excluded from further consideration. It is not necessary to adapt ATKIS and TBD together. The second group of objects is large enough that we can and we should use ATKIS data to power the topographic objects database for German and Polish border regions.

Objects in ATKIS and TBD are divided into three levels of detail. 1st Division (general) is presented in Table 1.

Table 1– Comparison of ATKIS and TBD (BDOT10k) databases

ATKIS	TBD (BDOT10k)
-	Watercourse networks (Watercourse networks)
-	Transport and railway networks (Transport networks)
-	Public utilities (Public utilities network)
-	Land coverage complex (Land coverage)
Gebäude (Buildings)	Buildings, structures and equipment (Buildings, structures and equipment)
Tatsächliche Nutzung (actual Use)	Land use complex (Land use complex)
Bauwerke, Einrichtungen und sonstige Angaben (Structures, objects, and other information)	Other objects (Other objects)
-	Protected areas (Protected areas)
Gesetzliche Festlegungen, Gebietseinheiten, Kataloge (Legal requirements, unit area, Catalogs)	Administrative divisions and record (Administrative division units)
Relief (Elevation)	Elevation

ATKIS and BDOT10k databases contain topographic objects. Because they refer to the same reality using the same tools, so they have the same or similar objects. However, these bases are different, because of obvious reasons formed independently of each other.

The first attempt to harmonize the topographic objects databases ATKIS and BDOT10k was taken in 2011 and was designed to use the harmonized base, to develop a Polish topographic maps and also to use it as a data source for geoinformation systems on the border between the Poland and Germany. This test was to develop the concept of a common database. The undertaken works and the analysis showed, how big are the differences in data models, object definitions, criteria of generalization, a variety of attributes, and text input, different coordinate systems, different ways of collecting data, different languages, etc. The second attempt in 2012, of using the data from topographic objects databases (ATKIS and BDOT10k) this time for the preparation of a simplified (with the presentation of the basic topographic information) form of topographic map in the scale of 1:10 000, as well impoverished form of database usable by other geoinformation systems. The attempt was to test the possibility of using the topographic data from the borders side, shared once by the geodetic and cartographic services, and in the future through continuous sharing of spatial data by WFS services.

The analysis of objects in databases was primarily aimed at selecting common objects. For this purpose both the base was analyzed. The analysis concluded that:

1. Part of objects are common. Define the same objects in the same way, eg. : building, community.
2. Part of objects are in the two databases, but they are defined differently, eg. :
  - fence in ATKIS database if its length is more than 500 m and a height of 2 m, in BDOT10k database lasting building has a length exceeding 100 m,
  - rivers placed in ATKIS database if the river width is more than 12 m, in BDOT10k database if river width is above 5 m,
  - the ground arable placed in ATKIS database if the surface is greater than 10 000 m<sup>2</sup>, in BDOT10k database if the surface is greater than 1 000 m<sup>2</sup> and width is above 15 m.
3. Part of objects are only in one of the database, eg.:
  - in a BDOT10k database are objects such as a bridge, pier, forest branch, while in ATKIS database are objects such as a network node, run, dock.

To harmonized database can be used all the objects that belong to one group (the objects that exist in two databases, and are defined the same) and some objects that belong to second groups (objects that appear in the two databases but their definition is different).

Subsequently, after the election of common objects, attributes of individual objects were analyzed in order to make a selection of common attributes and agree on attribute value. The selection subject only common attributes and attribute values were to be agreed. After such a thorough object - attributes analysis, the prepared data for the selected on the test areas on the polish – german border were imported under the scheme application in GML (Geography Markup Language) in to the BDOT10k database. In addition, rules have been developed to assign attributes from ATKIS to BDOT10k database. Conceptual model of the BDOT10k database in UML (Unified Modeling Language) has been developed in accordance with the methodology defined in the conceptual modeling of the international standards ISO 19100 series - Geographic Information.

In particular, on the basis of:

- PN-EN-ISO 19109:2006 (Geographic information - Rules for Application Schema);
- technical specification ISO/TS 19103:2005 (Geographic information - Conceptual schema language);
- PN-EN ISO 19110:2006 (Geographic information - Methodology for feature Cataloguing).

Conceptual model has been written in UML language as object-oriented methodology. Description of each class of objects in the application of UML diagram is a class consisting of:

- class name and the name of the stereotype;
- class attributes;
- relations connecting the class with the classes roles;
- restrictions on attribute values and their cardinality, relationships and objects cardinality in the relationship.

#### **4. Research works**

On behalf of Head Office of Geodesy and Cartography (GUGiK) in Warsaw, the company OPEGIEKA from Elblag worked on the test works on the test area covering four emblem of topographic maps of the border areas of Saxony and Mecklenburg border areas:

- 1) Statement of objects and attributes from BDOT10k database with the corresponding objects and attributes from ATKIS database, containing distinguish the following cases of relationship between objects and attributes in BDOT10k and ATKIS databases:
  - a) one object attribute from BDOT10k database corresponds to one object attribute from the database ATKIS;
  - b) one object attribute from BDOT10k database corresponds many objects attributes of different objects classes from ATKIS database;
  - c) one object attribute from ATKIS database corresponds many objects attributes of different objects classes from BDOT10k database;
  - d) one object attribute from BDOT10k database doesn't correspond to any object attribute from the database ATKIS;
  - e) one object attribute from ATKIS database doesn't correspond any object attribute from the BDOT10k database;
  - f) one object attribute from BDOT10k database corresponds many object attributes from the same object class in the ATKIS database;
  - g) one object attribute from ATKIS database corresponds many object attributes from the same object class in the BDOT10k database;
  - h) one object attribute from BDOT10k database corresponds a whole object class in the ATKIS database;
  - i) one object attribute from ATKIS database corresponds a whole object class in the BDOT10k database;
  - j) one object class from BDOT10k database corresponds in total one or more object classes in ATKIS database regardless of attributes;
  - k) one object class from ATKIS database corresponds in total one or more object classes in BDOT10k database regardless of attributes;
  - l) many object attributes from ATKIS database corresponds many object attributes from BDOT10k database.
- 2) Development of XSLT files in version 1.0 allow for transformation of GML files between BDOT10k and ATKIS schemas (XSD);
- 3) Migration of data obtained from the state geodetic and cartographic for topographic sheets 4 emblems topographic map at in the scale of 1:10 000 to the new BDOT10k structure in accordance with Regulation of the Minister of Interior and Administration dated November 17th,2011 on the topographic objects database and database of geographic objects as well as standard cartographic studies;



- 4) import data from the ATKIS database to BDOT10k database structure in accordance with the XSLT file as a continuous spatial database within each sheets of topographic map;
- 5) Resymbolization of combined database objects giving them a mapping code, according to Polish standards in this field, using a library from ESRI ArcGIS version 10.0.;
- 6) Edit topographic map in scale of 1: 10 000 .

## **5.Conclusions**

The most important conclusion of the system analysis (data model) was to determine the possibility of power the uniform data from ATKIS database of topographic features for border regions. Another result of the cooperation was visualization of completed topographic objects database in the border area on the topographic map in a scale of 1:10 000 using the symbols defined in the Polish technical standard. The next step is load uniform data to central access point [www.geoportal.gov.pl](http://www.geoportal.gov.pl). The point to work out is better data harmonization and verification of technical standards, during turning them into the 3D database.

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